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August 14, 2009

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street SW.
Washington DC 20554

Re: WT Docket No. 07-293
IB Docket No. 95-91
Ex Parte Comments

Dear Ms. Dortch:

Forwarded herewith on behalf of Aerospace and Flight Test Radio Coordinating Council ("AFTRCC") is an Engineering Statement prepared by Daniel G. Jablonski, Ph.D., of the Johns Hopkins University Applied Physics Laboratory.

The Engineering Statement reports the results of measurements taken by Dr. Jablonski during the recent WCS-Sirius XM field tests.

In particular, the measurements confirm the risk of interference to flight test telemetry from a proliferation of Wireless Communications Service devices operating under the rules proposed by the WCS Coalition. Together with the report filed by Sirius XM Radio, Inc., it is clear that the WCS proposals risk causing serious interference to both adjacent services, SDARS and AMT, the latter involving safety of flight.

Any questions regarding this filing may be directed to the undersigned.

Respectfully submitted,

William K. Keane
Counsel for Aerospace and Flight Test Radio Coordinating Council

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Engineering Statement

Measurement of Out of Band Interference from WCS devices to an Aeronautical Mobile Telemetry Receiver

Daniel G. Jablonski

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13 August 2009

This Statement is provided in connection with the recent demonstration of WCS base station and mobile devices in Ashburn, Virginia operating under the relaxed rules proposed by the WCS Coalition (WCS). Representatives of the Aerospace and Flight Test Radio Coordinating Council (AFTRCC) were present for the tests. Although the tests were conducted by representatives of WCS and XM/Sirius, AFTRCC was permitted to make measurements using a spectrum analyzer and a flight test telemetry receiver on a no-interference basis.

The measurements, summarized below, indicate that out of band emissions from WCS devices will, as expected, be detected as interference by a flight test telemetry receiver tuned to flight test frequencies in the adjacent band. This prediction is described in earlier filings to this docket, details of which are provided below.

On July 21st and 22nd, AFTRCC made spectrum analyzer measurements of the signals from an Alvarion base station transmitter and from mobile devices operated during the test by both the WCS Coalition and by XM/Sirius engineers. The details of these devices and their performance characteristics are described in filings by these parties.

It was found that spectrum analyzer measurements lacked the sensitivity and response times needed to capture key aspects of the interference environment. In particular, the noise temperature of the spectrum analyzer, when used with a low-gain, omni-directional antenna, was too high to permit accurate measurement, at a standoff distance of 60 – 300 feet, of the out of band emissions from the transmitters in question. Because of this, a low-noise flight test telemetry receiver, a Microdyne Model 1400 MRA, was utilized the second day. Using the same receive antenna, the telemetry receiver, with its greatly improved sensitivity, easily detected the signal from the WCS device. On this day, only the mobile device assembled by XM/Sirius was available for test.

The 1400 MRA receiver, with a tuner having a noise figure of 12 dB, was easily able to measure the OFDM signals from the XM/Sirius WCS mobile transmitter at a distance of approximately 60 feet. The upper band edge of the WCS device's modulated signal was known to be 2352.5 MHz. The center frequency of the receiver was set to 2362.5 MHz, with a 12 MHz IF bandwidth and an AGC time constant of 1 mS. Thus, the lower band edge of the AMT signal was 2356.5 MHz, providing a de facto 4 MHz guard band between the band edge of the WCS device and that of the AMT receiver.

Although the Microdyne receiver is configured to demodulate PCM-FM signals, it readily detected the OFDM signals from the mobile device. The interfering signal produced an audio output that was easily heard over the loudspeaker in the receiver. The corresponding changes to signal strength were measured at the "signal strength output" connector on the Microdyne receiver.

Figures 1 and 2 show oscilloscope traces of an audio recording of the receiver's loudspeaker and a plot of the signal strength output, both as functions of time. For these informal measurements, there are two key points:

1. The effect of the OFDM signal, with its 200 Hz frame rate, produces an audio output at a few kHz. Hence, there are complicated interactions involving the various time constants, inter-modulation products, etc. going on within the end-to-end system.
2. The variations in power versus time, presumably as a result of the high peak-to-average variations that are a defining feature of OFDM signals, are significant.

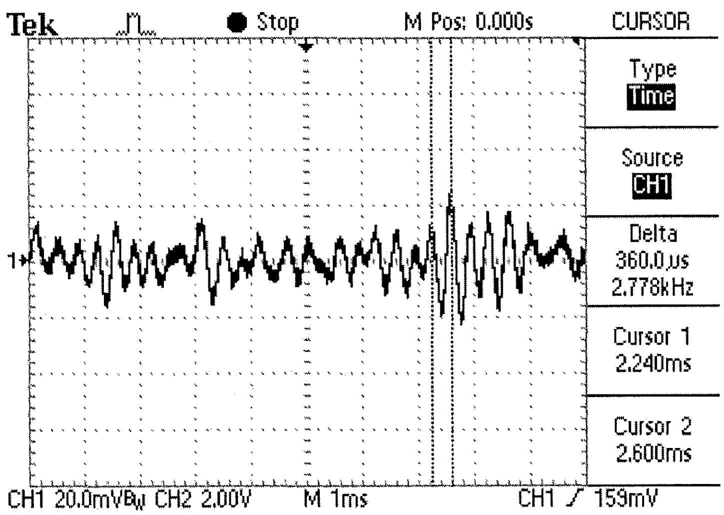

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Figure 1. Audio output of the out-of-band signal from a WCS mobile transmitter as received by a Microdyne 1400 MRA telemetry receiver.

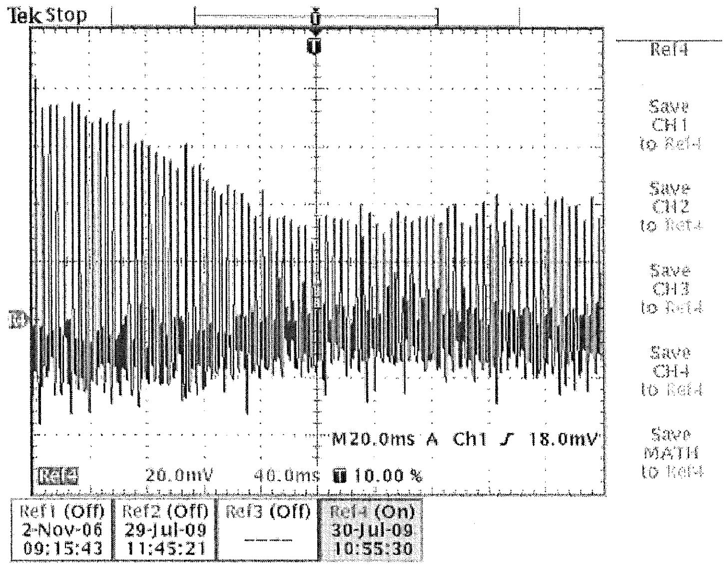

Figure 2. Strong variations in signal power of a WCS mobile device as evidenced by signal strength changes at the output of a Microdyne 1400 MRA receiver with the AGC time constant set to 1 mS.

The most important point is that, if the ad hoc arrangement used for these measurements were replaced with a high gain parabolic antenna (~40 dBi) connected directly to a low noise amplifier (noise figure of approximately 0.4 dB), the distance at which interference from a single WCS device will be detectable above the noise floor of the AMT system will be enormous. Indeed, the noise floor of the system will fall by 20 dB, and the antenna gain will increase by almost 40 dB. This adds about 60 dB of improvement in the total system sensitivity.

Every 6 dB of improvement in sensitivity yields a corresponding doubling of the distance at which the signal can be received.. So, the effects shown above, which are evident at a distance of 60 feet, will be the same for an actual AMT ground station at a distance of $2^{10} \times 60 feet = 11.6 miles$. The resulting signal from this single WCS device will still be well above the noise floor of the AMT system. Furthermore, the line of sight distances from AMT antennas are typically well more than 11.6 miles.

The results of this measurement do not consider the even more deleterious effects of tower mounted WCS base stations. Yet the results shown here indicate clearly that interference from the proliferation of mobile WCS devices to AMT ground stations, if proposed rule changes were put into effect, will be severe.

Furthermore, the complex power-versus-time behavior shown in Figure 2 indicates that permitting out of band emission levels to be measured using average power, rather than peak power, is very problematic.

Finally, the out-of-band rejection of the IF filter in the Microdyne receiver near the band edge is approximately 40 dB. This is comparable to the 43 + 10 log (P) roll-off of the WCS transmitter. Thus, the effectiveness of additional filtering at the AMT antenna, which was not used for these measurements, might also be considered. However, such filtering cannot protect against WCS out of band emissions that enter the IF bandwidth of the AMT receiver. In other words, the fact that interference is so readily detectable, even with a 4 MHz guard band, means that the impact of WCS deployment on the operation of AMT systems will be untenable.

David G. Jablonski